UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY
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OFFICE OF
AIR AND RADIATION

February 8, 2001 CCD-01-01 (LDV/LDT/SM/ICI/LIMO)

Dear Manufacturer:

Subject: Correcting "Negative" Calculated Emission Levels to Zero

Today's lowest emission vehicles (such as SULEV's) may generate emissions concentrations in the second bag of the FTP which approach the concentrations of the ambient air. This could lead to a calculation of a "negative" amount of emissions when using the calculation procedures specified in 40 CFR 86.144-94. It is not possible to actually have a negative mass of emissions during any phase of testing. Therefore, it has been the longstanding practice of EPA and CARB and most (if not all) manufacturers to correct "negative" calculated emission levels to zero before calculating the weighted bag emissions over the FTP.

This letter serves to remind manufacturers that the use of "negative" calculated emission values for any phase of testing does not constitute "good engineering judgment" as defined in 40 CFR 86.1851-01. Furthermore, EPA has determined that the use of such procedures result in "unsatisfactory testing" under the provisions of 40 CFR 86.1840-01 (Special Test Procedures). Consequently, EPA does not intend to accept weighted bag emission test results which are calculated using "negative" emission levels from any phase of the test.

The regulations (ref. 40 CFR 86.1803-01) define "exhaust emissions" as "substances emitted to the atmosphere...". The regulations also require that exhaust emission test results be calculated according to a specified formula that is structured to identify the actual amount of emission emitted from the tailpipe (ref. 40 CFR 86.144-94). Thus, the emissions that are regulated and measured are the absolute level of emissions from the tailpipe, not the difference between the tailpipe and the ambient atmosphere. This absolute level of emissions, like all physical bodies, may only have positive (or zero) mass. Any calculation which results in negative mass for any physical quantity must (by the laws of physics: "all matter has mass") be incorrect.

The constant volume sampling (CVS) test procedures and the associated calculation procedures include two simplifying assumptions, which, in very rare cases, could lead to the erroneous calculation of a negative mass of emissions. The first assumption is that the dilution air concentration is constant and therefore may be sampled at a constant rate. The second assumption concerns the calculation of the dilution factor (DF) which assumes a stoichiometric combustion to derive the numerator of the DF (13.4). These assumptions yield accurate and acceptable emission measurements in cases where the emission levels are significantly higher than the ambient.

However when the concentration of the dilute exhaust mixture approaches the concentration of the ambient air, these assumptions coupled with the variability inherent in any measurement system can result in a calculation of a "negative" mass of emissions. This situation is very rare and seems to be limited to the cleanest vehicles (SULEV vehicles) and has been observed with the hydrocarbon measurement in the second bag of the FTP (where the emission concentration is typically at the lowest level). To avoid the problems outlined above, any calculated "negative" mass of emissions should be adjusted to zero.

EPA still considers that the CVS measurement and its attendant calculation procedures yield acceptable results for most vehicles with emission levels above the ULEV standards.[1]

If you have any questions on this issue, please contact Eldert Bontekoe at 734-214-4442.

Sincerely,

Gregory A. Green, Director
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Office of Transportation and Air Quality

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[1]EPA has been reviewing new emission sampling technologies which appear more capable of measuring emissions at the very low levels associated with ULEV and cleaner vehicles. In particular, the bag mini-diluter (BMD) system has demonstrated its potential to accurately measure very low emission levels. Several manufacturers have approached EPA to allow the use of the BMD at their laboratories for ULEV and cleaner vehicles. We expect to be approving the use of BMD systems in the near future. Once we have completed our review, we will issue guidelines for BMD use. EPA also plans to procure a BMD for our own testing at NVFEL.